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OFFICE NOTE 254

1-2 Day Comparative BWB and LFM
Threat Scores and Bias 1971-1982

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This is an unreviewed manuscript, primarily
intended for informal exchange of information
among NMC staff members.

1-2 Day Comparative BWB & LFM Threat Scores and Bias

1971 - 1982

INTRODUCTION

Basic Weather Branch keeps a continuous record of precipitation threat scores and no precipitation threat scores for comparative purposes dating back to 1971. The Branch also keeps records of Bias (forecast over observed precipitation) which began in 1972 for the 24-12 hours and 1975 for the 36-12 hours. These records are kept to evaluate the effectiveness of the "man" and the guidance monthly, seasonally, yearly, and longer in order to evaluate objectively how the "man" and the model compare and to see if new models are overacting or underacting to precipitation related parameters.

Comparitive BWB and LFM Threat Scores and Bias

Figure 15 shows the Threat Score and Bias verification of measurable precipitation forecasts for 24-12 hours from 1971 to 1981. [Actually the LFM model began being used as primary precipitation guidance in October 1971, and Basic Weather 1-2 day forecasters deal primarily with the LFM. The Bias verification comparisons began in 1972.] The Threat Score for the PE-LFM models showed significant improvement in "1971-72" and again with the LFM in "73." Basic Weather also showed improvements from 1971 to 73. The next 2 years (73-75) show little change for either the LFM or the Basic Weather forecasters. In 1976 the LFM Threat Score dropped drastically and the Bias dropped below 1.00. During the same period the Basic Weather forecasters Threat Scores also dipped slightly (less than 1 point) and the bias dropped slightly. From 1976-79 the LFM Threat Scores showed steady improvement, while the 1-2 day forecasters Threat Score dropped. Then in 1977 the 1-2 day Threat Scores showed a steady improvement which continued until 1979. One other noticeable characteristic was a steady improvement of the "man" Threat Scores from 1977-1979 and a subsequent decline in Bias. This shows real forecasting skill. During this same period the LFM showed steady improvement in Threat Score.

In 1979-80 the LFM Bias averaged about 1.05 while the Threat Score showed a slight decline. Then in 1980-81 Basic Weather (24-12) Threat Scores rose slightly and so did the LFM; but the Bias rose way out of proportion to the increase in Threat Scores. The last 5 months of 1981 the LFM Bias averaged 1.56 a jump of 35% and the 1-2 day averaged 1.40 a jump of 15% over the average of the first 7 months of the year. There

was no comparable improvement in the Threat Scores of the LFM to merit this rise. In fact, the Threat Score average for the last 5 months of 1981 showed a decrease when compared with the first 7 months.

On Figure 2 at 36-12 hours a similar pattern emerges. [Bias comparisons begin with the LFM in 1975.] Here, except for the first year (1976 for T.S. and "77" for Bias), both the Threat Score and the Bias showed improvement. (Threat Score up and Bias down.) Then from 1979 to 1980 all of the Threat Scores went down and the Basic Weather Bias went down, but the LFM Bias went up slightly. Then from 1980-1981 the LFM-BWB Threat Scores showed only slight improvement but the Bias jumped up over the previous 3 years averaging 1.26 for the LFM and 1.23 for the BWB while only showing a slight increase in Threat Score for the BWB. During the last 5 months of "1981" when the Bias was at its worst the LFM averaged 1.47 and the 1-2 day 1.34.

Ideally, what we would like to see is an increase in Threat Scores during both 24-12 and 36-12 periods with a decrease in Bias or as near "1.00" as possible. What we do not like to see is a slight increase or no increase in Threat Score at all and a large increase in Bias. When this happens, the guidance and/or the "man" are not showing much skill.

On Figure 3 we see how Bias became a problem during the latter half of 1981. Up until August 1981 the 36-12 LFM Bias averaged out to 1.10. From August to December 1981, the Bias averaged 1.47 an increase of 34%. BWB also showed an increase in Bias. Up until August the Basic Weather Bias averaged 1.15. From August to December the Bias averaged

1.34 an increase of 17%. In that period the LFM broke three Threat Score records for the month "August, October, and December." On the other hand the BWB for the same period broke only one record for the month, "October."

During the period 24-12 hours LFM and Basic Weather also show increases in Bias. The first 7 months the Bias averaged 1.16 for the LFM. The next 5 months the Bias averaged 1.56 a jump of 35%. During the period when the Bias increased, the LFM only recorded one new record for the month, "August."

Basic Weather also increased its Bias. The first 7 months the Bias averaged 1.22. From August to December the Bias averaged 1.40 an increase of 15% about half of the LFM increase.

It would seem that the area to improve on the LFM is on "take outs" because the LFM, especially since August of "81," was overforecasting by about 30% from the earlier part of the year and certainly much more than prior years. This overforecasting by the LFM is not that rewarding. If one looks carefully at the monthly Threat Scores and Bias it becomes abundantly clear that the "man," after a rocky start in August "81", improved both the Bias and the Threat Score spread showing significant skill even though the LFM broke 4 monthly Threat Score records and the "man" only two in the last five months.

On Figure 4 we also notice an improvement in Basic Weather no precip-
itation scores and a decrease in LFM no precipitation scores. Basic
Weather is also showing a better percentage improvement in continuity
changes to the LFM at 36-12 and 24-12 periods.

During the 36-12 hour period BWB broke all time TSNP records in
January, and the LFM broke a record in January. At 24-12 hours
the LFM broke all time TSNP records in January, and Basic Weather
broke a record for the month of January.

Figure 1

THREAT-SCORE VERIFICATION OF MEASURABLE PRECIPITATION FORECASTS

12 TO 24 HOURS

FORECAST PERIODS 0000 TO 1200 AND 1200 TO 0000 GMT

QPB FORECAST COMPLETED 4 HOURS BEFORE BEGINNING OF FORECAST PERIOD

BWB FORECAST COMPLETED 6 1/2 HOURS BEFORE BEGINNING OF FORECAST PERIOD

50

45

40

35

30

25

QPB

TS%

BWB

TS%

PE

LFM

BWB

BIAS

LFM

BIAS VERIFICATION

BIAS VERIFICATION

LFM VS BASIC WEATHER BR.

24-12 HRS

69

70

71

72

73

74

75

76

77

78

79

80

81

82

Figure 2

THREAT-SCORE VERIFICATION OF MEASURABLE PRECIPITATION FORECASTS

24 TO 36 HOURS

FORECAST PERIODS 0000 TO 1200 AND 1200 TO 0000 GMT

PE: JAN - JUN 1975

LFM: JUL - DEC 1975

50

45

40

35

30

25

TS% PE

TS% BWB

LFM

BWB

BIAS

LFM

BIAS VERIFICATION

1.80

1.70

1.60

1.50

1.40

1.30

1.20

1.10

1.00

.90

.80

BIAS VERIFICATION

LFM VS BASIC WEATHER BR.

36-12 HRS

69

70

71

72

73

74

75

76

77

78

79

80

81

82

Figure 3

Comparative BWB and LFM Precipitation Scores
1981 Threat Scores and Bias
for 24-12 and 36-12 hours

<u>36-12</u>						<u>24-12</u>				
<u>LFM</u>			<u>Basic Weather</u>			<u>LFM</u>			<u>Basic Weather</u>	
<u>No.</u>	<u>T.S.</u>	<u>Bias</u>	<u>T.S.</u>	<u>Bias</u>		<u>No.</u>	<u>T.S.</u>	<u>Bias</u>	<u>T.S.</u>	<u>Bias</u>
J 62	33.54	.92	38.20	1.08		60	39.17	.94	44.23	1.13
F 54	42.79	1.07	46.77*	1.02		50	51.36*	1.09	54.36*	1.08
M 62	40.08	1.20	41.70	1.21		58	45.69	1.18	49.78	1.20
A 60	34.63	1.27	37.53	1.30		57	40.73	1.26	43.52	1.31
M 62	39.70*	1.07	40.37	1.15		59	43.21	1.11	46.62	1.21
J 58	32.93	1.06	35.93	1.14		52	35.99*	1.21	39.88*	1.27
J 61	33.08*	1.15	33.70	1.21		54	35.35*	1.36	37.78*	1.36
A 61	29.99*	1.38	33.33	1.50		59	33.08*	1.70	37.16	1.60
S 59	33.37	1.44	36.45	1.35		56	37.07	1.53	41.68	1.41
O 62	41.94*	1.41	47.48*	1.23		59	45.68	1.52	51.03*	1.35
N 60	37.90	1.69	45.24	1.38		58	44.17	1.63	50.00	1.39
D 62	41.18*	1.44	45.47	1.24		61	46.04	1.40	51.51	1.27
Averages/12 Months										
	36.76	1.26	40.18	1.23			41.46	1.32	45.63	1.29

* New records for month

*June 10, 1981 LFM moisture changed (approx.)

Bias Verification for LFM Vs Basic Weather Branch

<u>36-12</u>		<u>24-12</u>		
<u>LFM</u>	<u>BW</u>	<u>LFM</u>	<u>BW</u>	
1.10	1.15	1.16	1.22	(averages for first seven months)
1.47	1.34	1.56	1.40	(averages for next five months)

Other Bits and Pieces

36-12
Threat Score Point Spread
Over LFM For Year
 3.42

24-12
Threat Score Point Spread
Over LFM For Year
 4.17

Average Threat Score Over LFM
For First 7 Months

<u>LFM</u>	<u>BW</u>	<u>LFM</u>	<u>BW</u>
36.67	39.17	40.64	45.17
<u>Last 5 Months</u>		<u>Last 5 Months</u>	
36.87	41.59	41.21	46.28

Figure 4

TSNP Scores 1981

	<u>36-12</u>		<u>24-12</u>	
	<u>LFM</u>	<u>BW</u>	<u>LFM</u>	<u>BW</u>
J	87.66**	87.89**	89.06**	89.14*
F	82.08	84.05*	84.84	86.41
M	82.09	82.59	84.21*	85.70
A	80.44	81.27	82.40	83.50
M	78.73	78.12	79.83	80.35
J	75.03	75.74	73.99	76.07
J	78.94	78.40	76.13	78.58
A	76.94	77.45	75.31	78.25
S	80.22	82.11	80.64	83.58
O	76.95	81.38	77.61	81.84
N	79.92	85.12	83.17	86.69
D	75.90	80.21	78.65	82.57

The TSNP scores are all close until the end of the year when differentials of 3 to almost 5 points occur. This goes hand in hand with the increase in Bias and with practice the 1-2 day forecaster will be able to cut down the overforecast and improve both the precipitation Threat Score and the no precipitation Threat Score as well as the Bias.

$$\text{T.S.} = \frac{H}{F+O-H}$$

$$\text{CC} = \frac{\text{correct changes}}{\text{\#changes made}}$$

$$\text{TSNP} = \frac{*N-(F+O-H)}{N-H}$$

*60 stations

$$\text{Bias} = \frac{\text{Forecast}}{\text{Observed}}$$

** New All Time Records
 * New Records For Month